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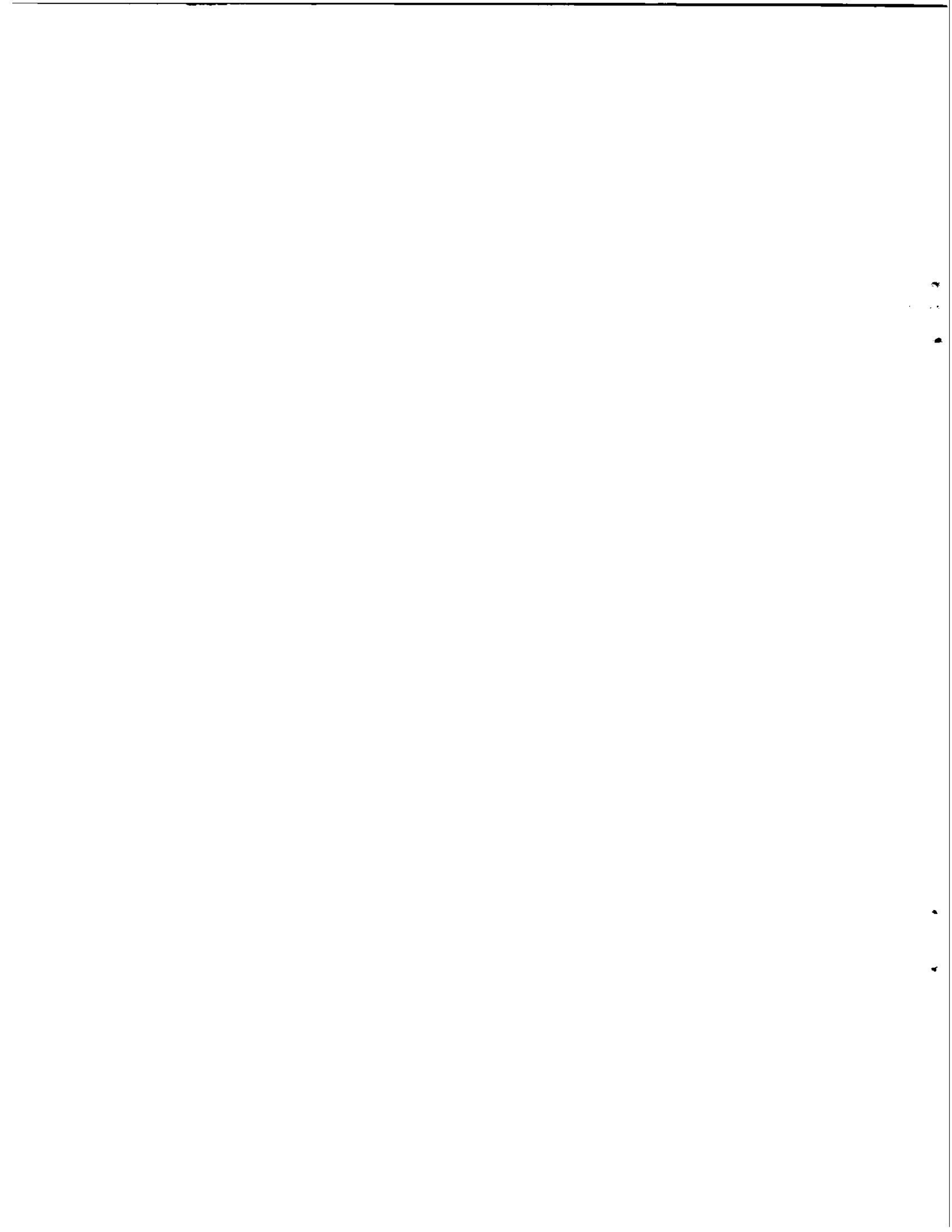
**UNIVERSITY OF PUERTO RICO
PUERTO RICO NUCLEAR CENTER
BUDGET FY-1978**

Project Proposals and Authorizations

RESEARCH PROGRAMS

**The contents of this document
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(Revised 5/14/76)

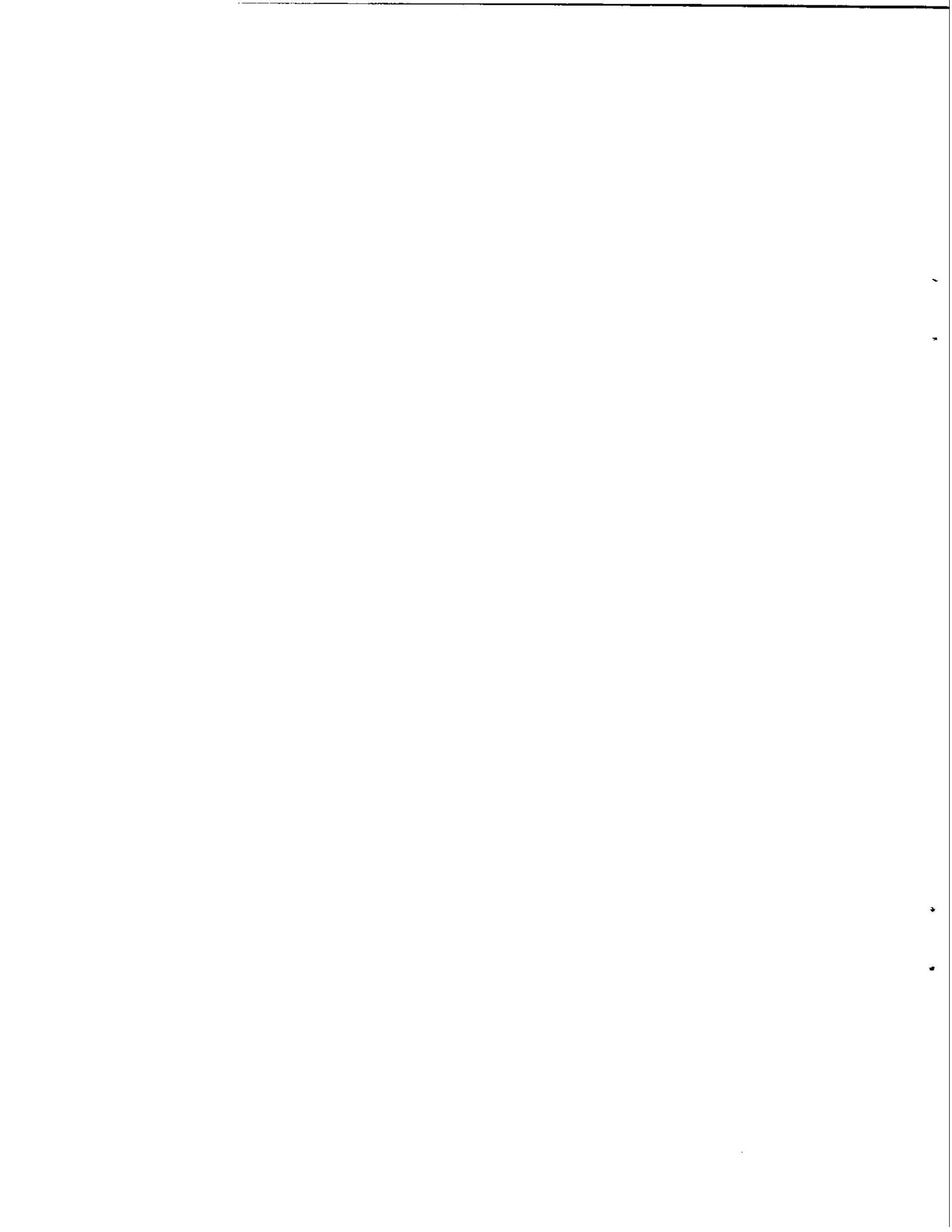


UNIVERSITY OF PUERTO RICO
Puerto Rico Nuclear Center

RESEARCH PROGRAMS

Terrestrial Ecology Program	1
Marine Pollution Studies	2
Health Impact of Hydroelectric Power Reservoirs	3
Environmental Research Park	4
Bikini	5
Epidemiological Models	6
Effects of Fossil Fuel Pollutants on Human Health	7
Marine Research Ship Operation	8





SCHEDULE 189

Additional Explanation for Operating Costs
University of Puerto Rico - Contract No. E-(40-1)-1833

BUDGET FY - 1978

Oak Ridge Operations

189 No. 21
Rev. 5/14/76

1. Project Title: Terrestrial Ecology Program
2. Security Classification or Project: Unclassified
3. Budget Activity No.: RT-03-01
4. Date Prepared: April, 1976
5. Method of Reporting: Annual Progress Report
6. Working Location: Rio Piedras
7. Person in Charge: Dr. Richard G. Clements
8. Project Term: Continuing Effort

9. <u>Man Years:</u>	<u>FY-1976</u>	<u>FY-1977</u>	<u>FY-1978</u>	
a. Scientific	5.0	1.00	3.95	5.95
b. Other Direct	<u>8.5</u>	<u>2.0</u>	<u>9.95</u>	<u>12.95</u>
	Total	13.5	3.00	13.90
10. <u>Operating Costs:</u>				
a. Direct salaries plus Fringe Benefits (from Appendix A)	137,800	29,900	134,600	190,277
b. Overhead Costs	103,300	22,400	75,400	106,535
c. Travel	2,000	1,000	4,000	8,000
d. Materials and Supplies	12,600	3,325	13,100	27,730
e. Other Services (Itemized in Item 19)	<u>19,300</u>	<u>5,875</u>	<u>22,900</u>	<u>27,458</u>
	Total	<u>275,000</u>	<u>62,500</u>	<u>250,000</u>

11. Equipment Obligations: 10,000 - 20,000 20,000

12. PUBLICATION AND RESEARCH PROGRESS

PROJECT TITLE	INVESTIGATORS	PROTOCOL PREPARED	DATA COLLECTED			MANUSCRIPT PREPARATION			PUBLICATION STATUS			JOURNAL
			In Part	Complete	Organized	Rough	Semi-Final	Final	Submitted	Accepted	In Press	
Hybrids in American Cyatheaaceae	D. S. Conant	X	X	X	X	X	X	X	X	X	X	Rhodora, 77: 812 (1975)
Electron Distribution in Some 1,2 Disubstituted Cyclooctatetraene Anion Radicals and Dianions	G. Stevenson J. Concepción-García A. M. Block	X	X	X	X	X	X	X	X	X	X	J. Phys. Chem., 79: 1968 (1975)
¹ Structure-Activity Correlations for Substituted Indole Acetic Acid	A. M. Block R. G. Clements	X	X	X	X	X	X	X	X	X	X	Int. J. Quantum Chem., QBS 2: 197 (1975)
Rainfall Interception Processes in a Tropical Rain Forest	R. G. Clements J. A. Colón	X	X	X	X	X	X	X	X	X	X	Proc. Mineral Cycling in S.E. Ecosystems, Augusta, Ga. (1974)
¹ Non-Photo Chemical Environmental Degradability of Synthetic Auxins	A. M. Block R. G. Clements	X	X	X	X	X	X	X	X	X	X	Int. J. Quantum Chem.
Molecular Orbital Calculations for the Isomers of 1,2,3,4,5,6-Hexachlorocyclohexane	A. M. Block R. G. Clements L. W. Newland*	X	X	X	X	X	X	X	X	X	X	Environ. Quality & Safety 'Pesticides', pp569-572, P. Koivistoinen - Ed., Thieme Verlag, Stuttgart, (1975)
¹ Ground State Electronic Properties of Plant Growth Inhibitors	R. G. Clements A. M. Block	X	X	X	X	X	X	X	X	X	X	Int. J. Quantum Chem.

¹Incorporated with other indicated projects

* ORAU Faculty Research Participant

12. PUBLICATION AND RESEARCH PROGRESS

PROJECT TITLE	INVESTIGATORS	PROTOCOL PREPARED	DATA COLLECTED		MANUSCRIPT PREPARATION			PUBLICATION STATUS			JOURNAL	
			In Part	Complete	Organized	Rough	Semi-Final	Final	Submitted	Accepted		In Press
Natural Environmental Radioactivity Measurement in Northwest Puerto Rico	F. Santos A. Banus A. M. Block R. G. Clements L. I. Rosa	X	X	X	X	X	X	X	X	X	X	Carib. J. Sci., (1975)
Equilibrium Studies by Electron Spin Resonance XIII. The Relationship Between Charge Density and Ion Pair Dissociation by the Use of g-Values	G. R. Stevenson A. E. Alegria A. McB. Block	X	X	X	X	X	X	X	X	X	X	J. Am. Chem. Soc. 97: 4859 (1975)
Radionuclides in Soils from Barrio Isote, Puerto Rico	A. M. Block R. G. Clements	X	X	X	X	X	X	X	X	X	X	
Spore Sampler for Simultaneous Collection of Spores at Several Sampling Points	D. S. Conant	X	X	X	X	X	X	X	X	X	X	
Growth Rate of <i>Cyathea arborea</i>	D. S. Conant	X	X	X	X	X	X	X	X	X	X	
Autecology of <i>Cyathea arborea</i> in the Mountains of Puerto Rico	D. S. Conant	X	X	X	X	X	X	X	X	X	X	
The Chemical Importance of the First Tenth of an Inch of Rainfall in a Puerto Rican Rain Forest	R. G. Clements J. A. Colón	X	X	X	X	X	X	X	X	X	X	Incorporated in the Rainfall Interception Process in a Tropical Rain Forest.
The Chemistry of Freshwater Streams in the Luquillo National Forest	R. G. Clements J. A. Colón	X	X	X	X	X	X	X	X	X	X	
Leaf Litter Fall in a Puerto Rican Rain Forest	R. G. Clements J. A. Colón	X	X	X	X	X	X	X	X	X	X	

12. PUBLICATION AND RESEARCH PROGRESS

PROJECT TITLE	INVESTIGATORS	PHOTOGRAPH PREPARED	DATA COLLECTED		MANUSCRIPT PREPARATION			PUBLICATION STATUS		JOURNAL	
			In Part	Complete	Organized	Rough	Semi-Final	Final	Submitted		Accepted
Distribution of <i>Cyathea arborea</i>	D. S. Conant	X	X	X	X	X	X				
The Distribution of Freshwater Shrimps in the Espiritu Santo River as Influenced by Physical-Chemical Factors	J. Villamil	X	X	X	X	X	X				
Lymnological Survey of the Espiritu Santo River and its Tributaries	W. Bhajan J. A. Colón M. Canals R. G. Clements	X	X	X	X	X	X				
New Species of Thelypteris from Puerto Rico	D. S. Conant	X	X	X	X	X	X				
Gametophyte Development of <i>Cyathea arborea</i>	D. S. Conant	X	X	X	X	X	X				
Spore Distribution of <i>Cyathea arborea</i> 1, 1-P Labeling	D. S. Conant	X	X	X	X	X	X				
Succession and Recovery of a Tropical Forest Following Gamma Irradiation : a 10-yr. Summary	E. Cuevas R. G. Clements A. Estrada	X	X	X	X	X	X				
Spectral Assignments for the Radical Cations and Radical Anions of Purine and Indole	A. M. Block R. Arce G. Simpson A. Jiménez	X	X	Discontinued due to change in research priorities.							

12. PUBLICATION AND RESEARCH PROGRESS

PROJECT TITLE	INVESTIGATORS	PROTOCOL PREPARED	DATA COLLECTED			MANUSCRIPT PREPARATION			PUBLICATION STATUS			
			In Part	Complete	Organized	Rough	Semi-Final	Final	Submitted	Accepted	In Press	
Ecology of <i>Caracollus caracolla</i>	R. G. Clements F. Santos	X	X									
Ecology of <i>Neritina rectizata</i>	W. Bhajan A. M. Block	X	X									
Survival of Freshwater Decapods as Influenced by Salinity Levels	W. Bhajan J. A. Colon M. Canals	X	X									
Rainage Network in the Upper Espiritu Santo Drainage Basin	B. Holben	X	X									
Spectral Assignments for the Radical Cations and Radical Anions of Purine and Indole	A. M. Block R. Arce	X	X	Discontinued due to change in research priorities.								
Solution Interactions of Alkali Metal Salts in Liquid Ammonia	A. M. Block W. Koehler	X	X	Discontinued due to change in research priorities.								
Vegetation Survey of the Upper Espiritu Santo River Basin	E. Cuevas R. G. Clements	X										
Solar Radiation Inputs to Terrestrial System	B. Holben											
Electron Spin Distribution in Fused Ring Cyclo-octatetraene Radical Anion Systems	R. Stevenson A. M. Block I. Ocasio M. Colon J. Esteves J. G. Concepción-			Discontinued due to change in research priorities.								

13. Reports and Presentations, FY-76

- a. Clements, R., E. Cuevas, J. Colón, A. Estrada and I. Ocasio, 1974. Terrestrial Ecology Studies of the NORCO-1 Site, Islote, Puerto Rico. USAEC Docket No. 50-376, Chap. 2.7, PRWRA.
- b. Cuevas, E. and R. G. Clements, 1975. Changes in Selected Water Quality Parameters as Influenced by Land Use Patterns in the Espiritu Santo Drainage Basin. PRNC-195, 70 pp.
- c. Block, A.M. and R. G. Clements, 1974. Pre-operational Monitoring for NORCO-1 Site, Islote, Puerto Rico. USAEC Docket No. 50-376, Chap. 6.3, PRWRA.
- d. Block, A.M., R. G. Clements and I. Parrish, 1974. Radiological Background Data for Puerto Rico. USAEC Docket No. 50-376, Chap. 2.8, PRWRA.
- e. Block, A.M., F. Santos, R. G. Clements, I. Rosa, and M. Banus, 1975. Thermo Luminescence Dosimetry in Northwest Puerto Rico. PRNC-191.

14. Purpose, Need and Scope

The purpose of the Espiritu Santo Drainage Basin Program is twofold: (1) to provide baseline ecological data for future environmental assessment studies at the local and regional level and (2) to determine through an ecosystem approach management alternatives for the wise utilization of energy, water and land resources. The study will describe the interrelationships among climate, vegetation, animals, soils and man and their combined influence upon the hydrologic cycle of the drainage basin both at the local and regional level. The entire drainage basin is considered as regional in size since it encompasses the origin of the river in the mountain to the final discharge into the Atlantic Ocean.

Environment management involves planning and decision making and both of these require data. At present, little is known about the interworkings of a complete, integrated system such as the drainage basin. While many isolated, ecologically oriented studies have been conducted in a tropical environment, few, if any, have provided the data base required for environmental management. In view of rapidly changing socioeconomic conditions and natural resources limitations, management urgently requires input data from three systems: (1) the physical (geological-meteorological), (2) biological and (3) cultural. This integrated study has been designed to provide these data. The scope of the Program will deal with the hydrologic cycle as it is affected by the interactions of the physical, biological and cultural systems. It will be multi-

disciplinary and utilize the team approach that has been developed within the Terrestrial Program to conduct integrated studies of the climate, soils, vegetation, animals and man. It will begin first with an intensive study of the forest segment of the drainage basin and then incorporate the agricultural lands and urban areas, and finally the estuarine system.

15. Relationship to Other Projects

The use of the drainage basin as a unifying concept has been and is being carried out at other locations such as Brookhaven, Hanford, and Holifield National Laboratories. The development of a complete drainage basin study in Puerto Rico would provide valuable information on tropical systems and complement the investigations at the other locations. Exchange of site visits between personnel of the Walker Branch Study at Oak Ridge and the Terrestrial Ecology Program of P.R.N.C. has been programmed. Where feasible, cooperative research will be developed between both programs.

16. Technical Progress in FY-76

A. Research Activities

The position papers covering the fields of hydrology, soils, plant ecology, animal ecology, limnology, climatology, chemistry and land use have been completed. The final collating and editing of these papers into the 5 year comprehensive research plan will be completed this fiscal year. Research investigations have begun in each of the above areas and are summarized in the following paragraphs.

1. Climatology

a. Rain Gage Network

A network of twenty storage rain gage stations have been installed in the forested region of the upper Espiritu Santo. Since little is known of rainfall throughout this area the purpose of this network is to provide preliminary data on spatial and temporal distribution of precipitation over the watershed. The data obtained will be used to determine the number and location of recording rain gages that will be required to provide input to the hydrology program.

These stations will also provide preliminary information on the chemistry of rainfall throughout the area. Currently these stations are being monitored on a bi-weekly basis.

b. Solar Radiation

The input of solar radiation to the study area is being approached from two directions, (1) direct measurement and (2)

theoretical. In the direct approach Sol-A-Meters calibrated against an Eppley Spectral Pyranometer are being used to provide estimates of solar input to the area. While these instruments will provide data for the energy budget, the theoretical approach will adjust for slope and aspect conditions. A computer model is being modified so that by gridding the study area and providing elevations, the slope and aspect of the study area can be analyzed. For the present time the model will assume cloud free conditions and maximum solar input determined only by the angle of incidence of the sun throughout the year. This estimated energy budget will then be adjusted according to the actual data obtained to provide the final energy budget.

c. Atmospheric Particulates

The Espiritu Santo Drainage Basin is not downwind from any major source of pollutants. As such, measurements of the atmospheric particulate concentrations and its chemistry should provide baseline levels of particulate matter from which future assessments can be made. This investigation is directed toward the determination of the contribution of atmospheric particulate matter to the terrestrial system both in quantity and chemistry.

2. Limnology

a. Survey of Rio Espiritu Santo

The purpose of this survey is to characterize selected physical and chemical properties of the system and to describe the flora and fauna. The survey has been divided into six parts. The first five cover a definite portion of the river system, namely Quebrada Jiménez, Quebrada Donadora, Quebrada Grande, Rio Espiritu Santo and its estuary. The sixth part will be a combination of the other sections. The data obtained will serve to identify the research priorities for the immediate future. The surveys have been completed with the exception of water chemistry. Reports are being prepared.

b. Bioassay of Some Freshwater Decapod Crustaceans

Eight species belonging to the Families, Atyidae, Palaemonidae and Pseudothelphusidae have been observed and reported in the Rio Espiritu Santo and its tributaries. Very little is known of the biology of these crustaceans. Epilobocera simatifrons, belonging to Family Pseudothelphusidae limits its distribution in freshwaters. It has been suggested that a marine phase is necessary for the Families Atyidae and Palaemonidae. However, preliminary investigation in 1971 suggest that it may be possible for the members of both families to complete their life cycle in freshwater. These bioassays are designed to test this theory.

c. The Ecology of Neritina reclinata

This brackish water neritid snail has invaded the freshwaters of Rio Espiritu Santo, and its tributaries. A report in 1959 noted that at El Verde, 70% of the snails were situated in pairs and one was attached to the dorso-posterior part of the other. The shell of the lower snail was eroded or being eaten by the attached one. No further research or observation has been carried out to elucidate this strange phenomenon. Hence, field observations and laboratory experiments to determine the role this snail plays in the ecology of Rio Espiritu Santo have been initiated.

d. The Influence of Physical-Chemical Factors on the Distribution of Freshwater Shrimps in the Espiritu Santo River.

This study was designed to study the distribution of shrimps in the upper Espiritu Santo River and correlate the distribution of each species with various physical-chemical factors.

3. Animal Ecologya. The Role of Caracolus caracolla in the Forest Ecosystem

The role of this snail in the detritus food chain is poorly understood. It is known to have diverse feeding habits including lichens, mosses, fungi, leaf litter, leaves and fruits. The purpose of this investigation is to study the ecology of this animal and its role in the dynamics of the forest ecosystem.

b. Population Dynamics of Caracolus caracolla

Currently underway is a study on the population of Caracolus caracolla at three different locations to study the effect of vegetation type and cover on the population levels. This study will complement the investigation described in A above.

4. Plant Ecology

a. Succession and Regrowth following Irradiation in a Tropical Forest.

This project is compiling the census data of the last ten years on the succession and regrowth of vegetation in the irradiated site at El Verde. It is one of the few sites in tropical areas where long term follow-up studies have been carried out. The census data for 1969, 1971, 1973 and 1975 have been transferred to IBM cards. Upon completing the transfer of 1967, and 1968, to data cards, the data will be analyzed to evaluate changes in species diversity, growth and other associated parameters. Final report should be available by the middle of FY-1977.

b. Vegetational Analysis in the Upper Espirita Sancho

The research proposal for this project is now in the final stages of preparation. It will treat the classification, description and mapping of vegetation throughout the 1200 acre tract of forest. The results will then be used to determine the location of permanent plots for biological studies.

5. Land Use

The Terrestrial Ecology has acquired a wide coverage of the Pradera Forest in the years of 1971, 1971, 1972, and 1973. Aerial photo interpretation has been used from photographs to prepare land use maps for different time periods and to identify major changes that have occurred. Scheduled for completion in FY-1977, these data will be the first for the formulation of management alternatives for the Espirita Sancho System.

6. Soils

Based upon data obtained from the U.S. Soil Conservation Service, a soil map of the northern Puerto Rican basin has been prepared. Approximately 8 soil types are present in the area and tabulation has been made of the total acres occupied by each type.

7. Hydrology

This area is inactive pending sufficient funds to modify the existing structure on the upper Espirita Sancho River to permit the measurement of streamflow. The equipment for monitoring streamflow is on hand. Estimated costs for necessary modifications could range between \$1,000 and \$6,000 and would have to be done during the dry season, February to April, during low flow. A study to determine the actual cost to modify the system will be completed this year.

B. Education and Training Activities

Research activities this year included the completion of a Master of Science degree in Biology at the University of Puerto Rico and a Ph.D. dissertation at Ohio State University. Research investigations were initiated for two Master of Sciences Degrees in Biology at the University of Puerto Rico and should be completed in late FY-76 or early FY-77. The titles are as follows:

<u>Name</u>	<u>Title of Thesis</u>	<u>Advisor Professor</u>
David Padgett	The Contribution of Aquatic Insects to the Decomposition of a Broad Leaf Litter. M.S. in Biology, Ohio State University.	J. Lagomour, OSU
		M. B. Clements, PRUC

Elvira Cuevas	*Changes in Water Quality as Influenced by Land Use Patterns. M.S. Biology, University of Puerto Rico.	R.G. Clements, PRNC
Johnny Willamil	The Influence of Physical Chemical Factors on the Distribution of Freshwater Shrimps in the Espiritu Santo River. M.S. Biol., University of Puerto Rico.	R.G. Clements, PRNC
Pedro Cebollero	Limiting Factors Affecting the Distribution of <u>Caracolus caracolla</u> in the Espiritu Santo Basin. M.S. Biol., University of Puerto Rico.	R.G. Clements, PRNC
María L. Lebrón	Recovery and Succession of Plants Following Gamma Irradiation of a Tropical Rain Forest. Ph.D. Dissertation, Univ. of North Carolina.	J. McCormick, Univ. of Tennessee R.G. Clements, PRNC

Construction of the new laboratory facility at El Verde is still pending and is now scheduled for completion in early FY-1977.

17. Expected Results FY-1977

The Program will continue to develop the major research areas set forth in Item 15. Upon completion of the surveys and preliminary investigations initiated in FY-76, the staff will review the results during FY-77 and propose definitive research investigations for FY-77 that are consistent with the research goals of the Program. It is anticipated that the permanent climatological stations will be installed in the 1400 acre tract of forest in the upper Espiritu Santo. These stations through a remote sensing system will provide daily information on rainfall, temperature and solar radiation throughout the area.

Completion of the vegetational survey and mapping of the forested area of the upper Espiritu Santo in FY-76, will permit the selection and marking of permanent plots for the determination of plant chemistry, litter production and turnover, phenology, seed production-germination and survival rates of the important species and the physical and chemical properties of soils associated with each vegetation type.

In limnology, work will be expanded on the population dynamics and feeding habits of the crustaceans. More definitive studies will be undertaken in the estuary. This will include the identification

*Thesis completed

on the species of fish that inhabit this portion of the river, the physical and chemical properties of the water and sediment analysis. It is necessary to establish the baseline conditions of this segment as early as possible because the middle section of the drainage basin is undergoing rapid changes and subsequent impacts will be reflected in this part of the system.

Beginning in FY-77, the physical and chemical analysis of the soil types present will be initiated. Bulk samples will be collected from each of the major horizons and determinations will include, cation exchange capacity, percent base saturation, major and minor elements, water holding capacity, moisture desorption curves and bulk density.

Hydrological studies on the upper Espiritu Santo are dependent upon availability of funds. (See item 15).

The work on plant succession following irradiation will be released as a PRNC publication during this year.

18. Expected Results in FY-1978

The Program will continue to develop along the guidelines set forth in the Research Plan and Item 16. At the end of FY-77 we will review internally the progress as related to the goals set forth in the Research Plan. We will request an external review of the Program and it will be modified and/or updated to meet the needs of ERDA.

19. Description and Explanation of Other Services

	<u>FY-1976</u>	<u>FY-1977</u>	<u>FY-1977</u>	<u>FY-1978</u>
Power	5,700	1,000	8,000	8,000
Shop Charges	500	1,000	--	--
Reproduction Charges	2,000	2,000	1,500	3,000
Trans. and Comm.	1,500	500	1,900	2,500
Equipment Maintenance	--	--	--	--
Tuition	800	--	--	--
Computer	--	--	--	--
Annual Leave	1,300	325	8,000	8,000
Vehicles	3,500	1,000	3,500	3,500
Miscellaneous	1,000	500	--	2,458
Electronic Charges	--	--	--	--
Rental of Equipment	--	--	--	--
Consultant Fees	2,000	--	--	--
Reactor Charges	--	--	--	--
	<u>-----</u>	<u>-----</u>	<u>-----</u>	<u>-----</u>
Total	\$19,300	\$5,875	\$22,900	\$27,458
	<u>-----</u>	<u>-----</u>	<u>-----</u>	<u>-----</u>

20. Description of Capital Equipment by Fiscal Year

Expenditures for FY-1977 will include the purchase of an environmental chamber for investigations such as growth studies and heat tolerance studies where a controlled environment is required. With the expanded field work in the mountainous areas a repeater station for our present radio network will be purchased. This will enable field crews to maintain communication with the base station at El Verde in case of an emergency or accident. Light weight aluminum crank-up towers are required for the permanent installation of our rainfall, temperature, solar radiation grid network in the research area. Smaller items totaling \$4,500 will be purchased to support on-going research.

In FY-1978 we are programming the establishment of a weather station at the El Verde site and will require the acquisition of a Solar Integration integrator, wind monitoring equipment and a net radiometer. Increased staff and research activities require a programmable calculator, X-Y plotter to replace present calculator which is now outdated. Miscellaneous items to support field research will total approximately \$5,000.

APPENDIX A

Position	Name	Time Devoted	Remarks	FY-1976	FY-1977	FY-1978
Scientific Personnel:						
Senior Sci. I	Richard G. Clements	85% FY-76, 82%-FY-76, FY-77, FY-78		18,579	14,640	17,918
Scientist II	Arthur McB. Block	100% FY-76, 82%-FY-77, FY-78		16,517	13,940	13,940
Scientist I	William Bhajan	100% FY-76, 82%-FY-76, FY-77, FY-78		14,000	11,480	11,480
Scientist I		100% To be appointed Oct. 1977		-	-	16,000
Sci. Assoc. III	Elvira Cuevas	100% FY-76, 82%-FY-76, FY-77, FY-78		9,340	6,200	8,200
Sci. Assoc. III	Brent Holben	100% FY-76, 82%-FY-76, FY-77, FY-78		9,600	7,872	7,872
Sci. Assoc. III	Fred Ia. Caro	100% Resigned 8/17/75		1,239	-	-
Sci. Assoc. III		100% To be appointed Oct. 1977		-	-	10,000
Other:						
Sci. Assoc. II	José A. Colón	100%		7,600	7,600	7,600
Res. Assoc. II	Félix Santos	100%		6,600	6,600	6,600
Res. Assoc. I	Miguel Canals	100%		6,000	6,000	6,000
Res. Assoc. I		100% To be appointed Oct. 1977		-	-	6,000
Res. Assoc. I		100% To be appointed Oct. 1977		-	-	6,000
Res. Assoc. I		100% To be appointed Oct. 1977		-	-	6,000
Res. Ass. III	Alejo Estrada	100%		5,800	5,800	5,800
Res. Ass. II	Jaine Villalba	100%		4,920	4,920	4,920
Res. Ass. II	Juan Martínez	100%		4,920	4,920	4,920
Res. Ass. II	Luis E. Rosa	100%		4,800	4,800	4,800
Res. Assoc. I	Johnny Villamil			1,600	-	-
Res. Assoc. I	Pedro Cebellero			1,100	-	-
Adm. Ass. II-Sec.	Ana J. Correa	90% FY-76, FY-76, FY-77, 100%-FY-78		5,700	5,700	6,300
Res. Assoc. I		50% To be appointed 10/1/76		-	3,200	3,200
Res. Assoc. I		50% To be appointed 10/1/76		-	3,200	3,200
Res. Assoc. I		50% To be appointed 10/1/76		-	3,200	3,200
Res. Assoc. I		50% To be appointed 10/1/76		-	3,200	3,200
				118,606	115,272	163,150
Gross Salaries				3,100	2,800	3,760
Bonus				16,101	16,530	23,367
Fringe Benefits				137,809	134,602	190,277
TOTAL						

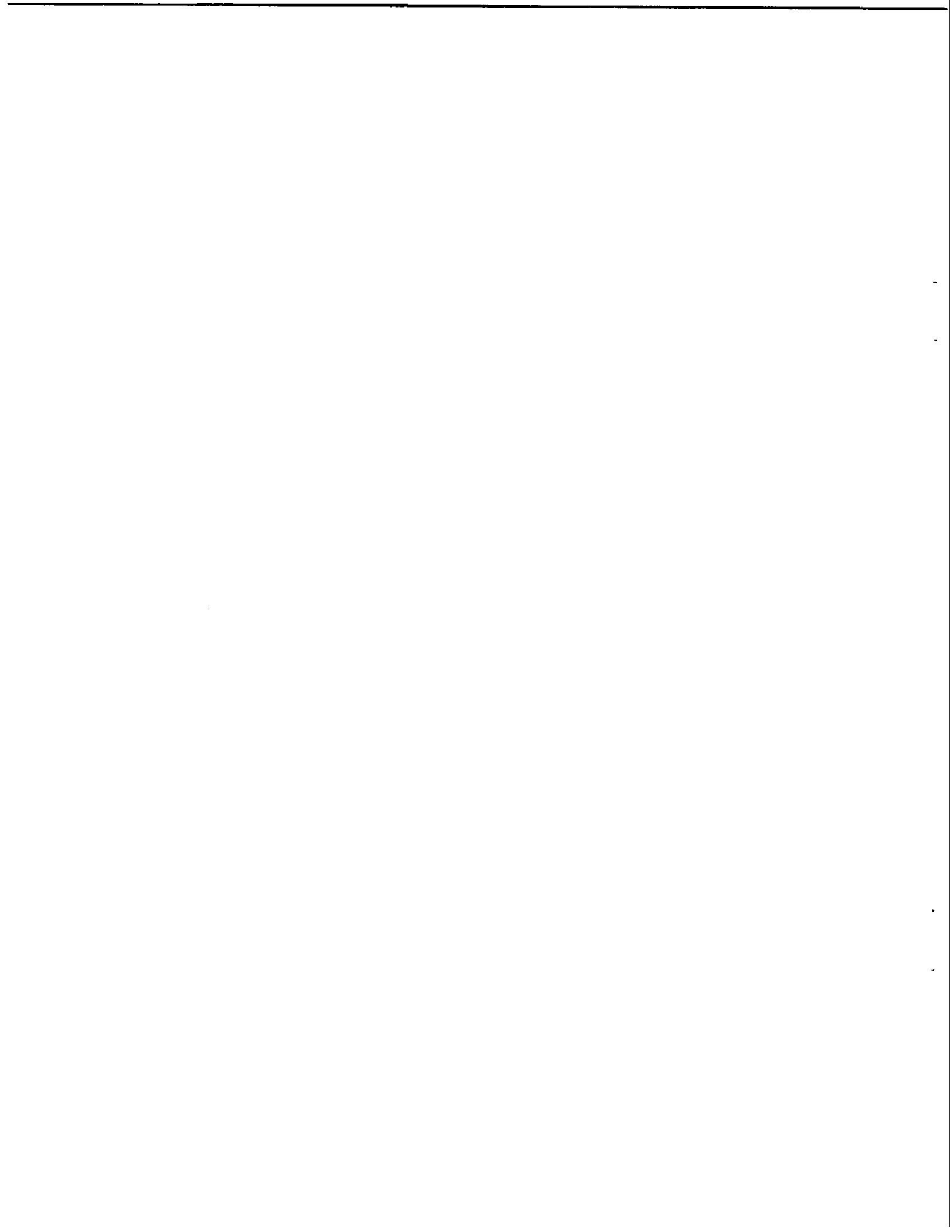
Terrestrial Ecology Program

APPENDIX B

COST OF EQUIPMENT

Description	FY-1976	FY-1977	FY-1978
Environmental Chamber	-	6,000	-
Repeater, Station Communication Network	-	2,500	-
Instrument Towers (7)	-	7,000	-
Miscellaneous Items	-	4,500	-
Recorders, Strip Chart (3)	-	-	3,000
Solar Insolation Integrator	-	-	2,000
Wind Monitoring Equipment	-	-	2,500
Net Radiometer	-	-	1,500
Calculator, Programmable	-	-	2,100
X-Y Plotter & Blocks	-	-	3,900
Miscellaneous Items	-	-	5,000
Total	-	\$ 20,000	\$ 20,000





SCHEDULE 189

Additional Explanation for Operating Costs
University of Puerto Rico - Contract No. E-(40-1)-1833

BUDGET FY - 1978

Oak Ridge Operations

189 No. 13
Rev. 5/14/76

1. Project Title: Marine Pollution Studies
2. Security Classification: Unclassified
3. Budget Activity No.: RT-03-01
4. Date Prepared: April 1976
5. Method of Reporting: Annual Report
6. Working Location: Mayaguez, Puerto Rico
7. Person in Charge: Dr. J. G. González
8. Project Term: Continuing Effort

9. <u>Man Years:</u>	<u>FY-1976</u>	<u>FY-1977</u>	<u>FY-1978</u>
a. Scientific	6.53	7.47	9.47
b. Other Direct	7.38	6.00	8.00
	<u>13.91</u>	<u>13.47</u>	<u>17.47</u>
Total	13.91	3.02	13.47

10. Operating Costs:

a. Direct salaries plus Fringe Benefits (from Appendix A)	151,300	51,200	163,900	227,200
b. Overhead Costs (56% of a.)	113,500	29,000	91,800	127,200
c. Travel	8,000	7,000	4,000	8,000
d. Materials and Supplies	17,000	5,000	13,300	18,100
e. Other Services (Itemized in Item 19)	35,200	8,000	37,000	32,500
Total	<u>\$325,000</u>	<u>\$100,200</u>	<u>\$310,000</u>	<u>\$413,000</u>

11. Equipment Obligations: \$ 26,000 --- \$ 40,000 \$ 40,000

12. PUBLICATION AND RESEARCH PROGRESS

PROJECT TITLE	INVESTIGATORS	PROTOCOL PREPARED	DATA COLLECTED			MANUSCRIPT PREPARATION			PUBLICATION STATUS			JOURNAL
			In Part	Complete	Organized	Rough	Semi-Final	Final	Submitted	Accepted	In Press	
Lead, Zinc & Cadmium Budgets in Experimentally Enriched Salt Marsh Ecosystems	M. D. Banus I. Valiela J. M. Teal	X	X	X	X	X	X	X	X	X	X	Estuarine Coastal Mar. Sci. 3: 391-412 (1975)
Floating, Rooting and Growth of Red Mangrove (Rhizophora mangle L.) Seedlings: Effect on Expansion of Mangroves in S.W. P.R.	M. D. Banus S. E. Kolehmainen	X	X	X	X	X	X	X	X	X	X	Proc. Int. Symp. Biol. Management of Mangroves U. Florida (1975)
Individual Variation of Trace Metals Content in Fish	M. D. Banus S. E. Kolehmainen J. Montgomery	X	X	X	X	X	X	X	X	X	X	Proc. 7th Mat. Res. Symp., U.S. Printing Off. (1976)
Rooting and Growth of Red Mangrove Seedlings from Thermally Stressed Trees	M. D. Banus S. E. Kolehmainen	X	X	X	X	X	X	X	X	X	X	Thermal Ecol. II (Conf. 750425) NITS-U.S. Dept. of Comm. 1976
Trace Metals in Mangrove Seedlings from Polluted and Unpolluted Bays in P.R.	M. D. Banus	X	X	X	X	X	X	X	X	X	X	Proc. 15th Hanford Life Sci. Symp. Richland, Wash. Oct. 1975
Natural Environmental Radioactivity Measurements in N.C. Puerto Rico	Felix Santos M. D. Banus A. M. Block R. Clements L. I. Rosa	X	X	X	X	X	X	X	X	X	X	Carib. J. Sci.

12. PUBLICATION AND RESEARCH PROGRESS

PROJECT TITLE	INVESTIGATORS	PROTOCOL PREPARED	DATA COLLECTED		MANUSCRIPT PREPARATION			PUBLICATION STATUS		JOURNAL	
			In Part	Complete	Organized	Rough	Semi-Final	Final	Submitted		Accepted
Ionic, Particulate and Organic Forms of Zn and Cu in the Guanajibo River and Coastal Zones.	J. Montgomery R. J. Santiago	X	X	X	X	X	X	X	X	X	Proc. 4th Nat. Symp. on Radioecology, Corvallis, Ore. (1975)
Individual Variation of Trace Metal Content in Fish	J. Montgomery S. Kolehmainen M. D. Barus	X	X	X	X	X	X	X	X	X	Proc. 7th Mat. Res. Symp. NBS, Gaithersburg, Md. (1974)
Leaching of Heavy Metals from Secondary Treated Sewage Sludge by Sea Water and Possible Pathways in Tropic Marine Ecosystem	J. Montgomery M. Price J. Thurston G. Laite H. Serra	X	X	X	X	X	X	X	X	X	Proc. Int. Conf. Heavy Metals in the Environ., Ont. Canada (1975)
Monitoring of an Atomic Absorption Spectrophotometer Using Cumulative Sum Statistical Control Charts	J. Montgomery	X	X	X	X	X	X	X	X	X	Proc. 7th Mat. Res. Symp. NBS, Wash. D.C. (1974)
A Survey of Fishes from Barrio Isote on the North Coast of P.R.	J. J. Kimmel	X	X	X	X	X	X	X	X	X	Proc. Am. Soc. Ichthyologists and Herpetologists, Williamsburg, Va. (1975)

Marine Pollution

12. PUBLICATION AND RESEARCH PROGRESS

PROJECT TITLE	INVESTIGATORS	PROTOCOL PREPARED	DATA COLLECTED			MANUSCRIPT PREPARATION			PUBLICATION STATUS			JOURNAL
			In Part	Complete	Organized	Rough	Semi-Final	Final	Submitted	Accepted	In Press	
Survey Sampling in the Environmental Sciences: A Computer Approach.	M. E. Nutt, J. P. Barrett	X	X	X	X	X	X	X	X	X	X	Project COMPUTER Kiewit Computation Center, Dartmouth Coll Hanover, N.Y. 266pp.
Copepoda, Chapter 8. In Geise and Pearse- Reproduction of Marine Invertebrates	M. E. Nutt, E. H. Wheeler	X	X	X	X	X	X	X	X	X	X	Vol. V Academic Press
Zooplankton of the Puerto Rican North Coast: A One Year Study	M. E. Nutt	X	X	X	X	X	X	X	X	X	X	Bull. Mar. Sci. (1976)
A Year Long Study of Zooplankton from the North Coast of P.R.	M. E. Nutt	X	X	X	X	X	X	X	X	X	X	Paper presented: AIML of Carib. St. Croix, V.I.
Organically Complexed Copper and Zinc and Chelating Agents in the waters of Western Puerto Rico.	J. Montgomery Jose Echevarria	X	X	X	X	X	X	X	X	X	X	Mineral Cycling in South eastern Ecosystems AEC Symp. Savannah River Res. Lab. 1975
Multiple Linear Regression Model of Dissolved Inorganic Phosphate in Lafayette River, Norfolk, Va.	J. Montgomery	X	X	X	X	X	X	X	X	X	X	Paper presented: A.L.S.O. Conf., Seattle, Wash.
Acid, Water and EDTA Soluble Fractions of Trace Metals in Coral Reef Sediments.	J. Montgomery	X	X	X	X	X	X	X	X	X	X	

12. PUBLICATION AND RESEARCH PROGRESS

PROJECT TITLE	INVESTIGATORS	PROTOCOL PREPARED	DATA COLLECTED		MANUSCRIPT PREPARATION			PUBLICATION STATUS		JOURNAL	
			In Part	Complete	Organized	Rough	Some Final	Final	Submitted		Accepted
Survival and Growth of Red Mangrove Propagules in a Thermally Stressed Lagoon at Guayanilla P.R.	M. D. Banus	X	X	X	X	X					
Trace Metals in Thread Herring from an Unpolluted Bay in P.R.	M. D. Banus , J. Montgomery	X									
Trace Metals Uptake by Red Mangrove Seedlings in Sewage-sludge Enriched Tropical Ecosystem.	M. D. Banus , J. Montgomery, M. Price	X	X								
Hydrocarbons in the Water and Sediments in Guayanilla and Tallaboa Bays, P.R.	M. D. Banus J. Castrillón	X	X								

13. Reports and Presentations, FY-1976

- Vicente, Vance P. . Benthic Invertebrates of Punta Higuero Power Plant Environmental Studies. PRNC-174
- Vicente, Vance P. . Ecological Aspects of the Sea Grass Communities of Jobos Bay, PRNC-196
- Kimmel, J.J., R. Castro and P. Davis, 1975. La Chalupa Mission #12 Final Report. PRNC-178
- Kimmel, J.J. . A Survey of Fishes from Barrio Islote on the North Coast of Puerto Rico. 11th. Meeting of the Association of Island Marine Laboratories Conference, St. Croix, V.I.
- Kimmel, J.J., 1975. A Survey of Fishes from Barrio Islote on the North Coast of Puerto Rico. USARC Docket No. 50-376, Chap. 2.7 PRWRA.
- Montgomery, J., 1975. Multiple Linear Regression Model of Dissolved Inorganic Phosphate in Lafayette River, Norfolk, Virginia. Paper presented at A.I.S.O. Conference, Seattle, Washington, D.C.
- Montgomery, J. and R.J. Santiago, 1975. Ionic, Particulate and Organic Forms of Zn and Cu in the Guanajibo River and Coastal Zones. 4th. National Symposium on Radioecology, Corvallis, Oregon.
- Montgomery, J., S. Kolehmainen and M. Bamus, 1975. Individual Variation of Trace Metal Content in Fish. Nat. Bur. of Standards - 7th. Mat. Res. Symposium, Gaithersburg, Md.
- Montgomery, J. et. al., 1975. Leaching of Heavy Metals from Secondary Treated Sewage Sludge by Sea Water and Possible Pathways in a Tropical Marine Ecosystem. International Conf. on Heavy Metals in the Environment. Ottawa, Ontario.
- Nutt, M.E., 1975. Zooplankton Studies, 1974, in Tortuguero Bay Environmental Studies. PRNC-181, pp. 49-55.
- Nutt, M.E., 1975. Zooplankton Studies 1974 in Pt. Manatí Environmental Studies. PRWC-182, pp. 51-56.
- Nutt, M.E., 1975. Zooplankton Studies 1974 in Pt. Higuero Environmental Studies. PRNC-183, pp. 51-56.
- Nutt, M.E., 1975. Zooplankton Studies 1974-75 in Islote Environmental Studies, PRNC-190.
- Nutt, M.E., 1975. A Year Long Study of Zooplankton from the North Coast of Puerto Rico. Paper presented at A.I.M.L. of Caribbean, St. Croix, V.I.

14. Purpose, Need and Scope

The purpose of the Program is twofold: (1) to investigate and evaluate the effects of stresses on the coastal marine environment associated with the continuing development of the largest energy producing and petrochemical complex in Puerto Rico and (2) to determine the management alternatives for the wise utilization of energy and marine resources.

The energy complex lines the shores of the Guayanilla and Tallaboa Bays which are protected by offshore reefs and cayos. The dominant current is from east to west. This current carries pollutants through Tallaboa Bay into Guayanilla Bay and then out to the sea. Tallaboa Bay is fairly open to the sea, whereas water movement in Guayanilla Bay is restricted by a narrow channel, thus favoring the accumulation of pollutants. The source of pollutants is the energy complex on the eastern side of the bay which includes an oil refinery, a fossil fuel power plant and downstream petrochemical plants. While many independent studies have been conducted in the area, there is a need for an integrated research approach to investigate and evaluate the effects and fates of pollutants introduced into the Guayanilla Bay.

An integrated team approach will be used to investigate the interaction of physical, chemical and biological systems in the Guayanilla-Tallaboa Bay area. The research will identify and characterize the pollutants in the area and attempt to describe their transport within and through the bay ecosystem. The stresses on the biological systems caused by these pollutants will be measured and evaluated. Programmatic research over the next five years will be determined by a comprehensive research plan now being developed.

15. Relationship to Other Projects

Cooperative programs are in effect with the University of Miami, Oak Ridge Associated Universities, University of Puerto Rico, Puerto Rico Department of Agriculture and the Department of Natural Resources.

16. Technical Progress in FY-1976

A. Research Activities

The Program is preparing a comprehensive plan to order the research investigations in the Guayanilla Bay area for the next five years. Seven research areas have been identified and position papers are being prepared for each area. These areas are: Chemical Oceanography, Physical Oceanography, Geological Oceanography, Mangrove Ecology, Fish, Plankton, and Benthic Biology.

The purpose of the papers is to summarize what is known in each of the areas as it relates to the study area. Based upon this knowledge needed research investigations will be identified and assigned priorities within the integrated plan. Presently the papers are being reviewed internally by the staff and when completed will be sent out for outside review. It is anticipated that this document will be ready by the beginning of FY-1977.

A reduction of three in the scientific staff has forced the re-organization of work that was scheduled for this year. Work has continued this year on: Trace metal pollutants in sea water and sediments; The effect of thermal plume and energy-related heavy metals on the mangroves, turtle grass beds and their associated organisms; and Field experiments on the effects of elevated temperatures and energy related pollutants and physical oceanography of Guayanilla Bay and adjacent nearshore areas.

The research activities and progress in each area is described in the following paragraphs:

A. Physical Oceanography

The role of the physical oceanography program this year has been to provide supplemental background data in support of research by other investigators. Three cruises were made covering the Guayanilla - Tallaboa Bays and surrounding marine Coastal areas. Twenty stations were monitored and measurements were taken on temperature, salinity, depth, dissolved oxygen, and phosphate and nitrate concentrations.

B. Mangrove Ecology

A lagoon in Guayanilla Bay receives the thermal discharge from the energy complex located on the eastern shore. Approximately one-half of the shoreline of this lagoon supports a mangrove community of the fringing type. On the land side of this mangrove there are a series of man-made ponds which receive waste discharges from the energy complex. Smoke from flare stacks and waste chemical burners flow over the mangrove. Two studies this year have dealt with thermal stresses and trace metal uptake. These are:

1. Seedling Survival and Growth

The objectives of this study are to determine if the growth and survival of seedlings from stressed areas are comparable to seedlings from non-stressed areas when grown in the thermal lagoon area. During the summer when maximum temperatures of 37-40°C are found in the lagoon, none of the seedlings root, grow and survive as they do in non-stressed areas. When seedlings from the stressed areas are grown in the normal sea water, survival and growth were found to be inferior to that of seedlings from non-stressed areas. When small trees grown from seeds of non-stressed areas, were

transplanted in the thermal lagoon, no individuals survived after two weeks with temperature varying between 38-40°C. When this experiment was repeated during the winter months with water temperatures of 33-35°C, growth and survival of seedlings was comparable to the control areas. These studies will be repeated under controlled conditions in the Aquarium Laboratory.

2. Trace Metal Uptake by Mangrove Seedlings

The purpose of the study is to determine the uptake of Fe, Mn, Zn, Cd, Pb, and Cr by young trees from polluted sediments. It also will determine where in the plants does concentration occur. Seedlings were grown in tanks enriched with sewage sludge and levels were compared to seedlings growing at six different locations with various burdens of the trace metals. Preliminary data indicate levels of Cu, Mn and Fe in the plants are related to the location and possibly pollution level. This study will be completed in early FY-1977.

3. Effect of Stress on Productivity of Mangroves

This is a new project to be initiated in FY-1976 with a duration of two years. It is designed to assess the effects of thermal stress on productivity. It will involve both field and laboratory determinations of primary productivity and respiration of plants at various temperatures. Productivity and respiration of trees from stressed and non-stressed areas will be compared.

4. Effect of Stress on Mangrove Detritus Production and Quality

This new project will begin in late FY-1976 with a duration of approximately two years. Its objectives will be to determine the effects of thermal and chemical stress on the rate of detritus production and its nutritional content. Litter bags will be used to evaluate the rate of detritus formation, extent of grazing, population of grazers and the material will be analyzed to determine the changes in nutrient content and the accumulation of trace metals.

C. Chemical Oceanography

Reconnaissance cruises of the Guayanilla-Tallaboa area were conducted in order to establish current levels and variability of various environmentally important chemical constituents in the area of water and sediments. A total of 22 stations were established and sampled. Water samples were collected at several depths and grab samples of the surface sediments were also obtained at all stations. In situ determination of temperature, salinity, dissolved oxygen and pH were performed during monitoring of the sampling stations.

Trace heavy metal analyses were performed for Cu, Zn, Cd, Cr, Ni, Mn and Fe on water and sediment samples. The distribution of these elements with depth at the various stations have been determined with regard to the various physicochemical forms that exist in the aqueous marine environment. The analytical techniques used included Anodic Stripping Voltametry, the Heated Graphite Atomizer Flameless technique and other flame Atomic Absorption Spectroscopic techniques. Comparison of results by the various techniques is being used to evaluate precision and accuracy of the data. In addition, water samples have been analyzed for BOD, phosphate and nitrate to determine the distribution of these parameters with depth at the various stations.

Surface sediment samples were partitioned among a range of size fractions by using sieving techniques. Total trace heavy metal determinations upon strong acid digestion were performed to determine total metal distribution as a function of particle size in the surface sediment. These size fractions were further characterized for the readily available content of trace heavy metals as defined by leaching with a reducing dilute acid solution. Flame atomic absorption spectroscopy was used in the determinations. Data reduction and analysis is underway.

D. Fish Biology

1. A Survey of the Fish of the Guayanilla Bay

Beginning in July, 1975, a survey was initiated to collect and identify the fish found in the Guayanilla-Tallaboa Bay areas. In addition to the identification, measurements were taken on length, weight, species, sex spawning condition, and food habits. Data were also taken on temperature, salinity, habitat, and spatial and temporal distribution. The data will be subjected to a correlation analysis to determine the interrelationship between the variables measured and the pollution and/or stress levels found.

E. Plankton Biology

The biomass, abundance, and species composition of zooplankton in Guayanilla Bay have been monitored monthly since September, 1975. Results from this survey show the copepod *Acartia tonsa* to be clearly the most important zooplankton form in the shallow areas of the bay. Field and laboratory research has therefore been initiated to investigate the effects of thermal stress on this organism. Vital staining techniques were used to estimate the percentage of living and dead copepods in thermally polluted areas of the bay. A series of survival, respiration, and excretion experiments are being carried out in the laboratory to evaluate the effects of elevated temperature on this copepod. This work will be completed during FY-1976.

F. Marine Geology

Sediments samples have been taken from Tallaboa and Guayanilla Bays in order to study the living and dead foraminifers. One of the purposes of the study of the foraminifers is to use them as environmental indicators. The number of foraminifers, the species and the species diversity is being determined for this purpose. Biometry is also being used. The results in Tallaboa Bay indicate that dwarf populations of Ammonia catesbyana have developed and its constitutes a unique feature in the waters surrounding Puerto Rico. Some depauperate foraminifers of other species are so deformed that they can not be identified. Populations of other foraminifers appears to be normal.

Living specimens of Ammonia catesbyana have been collected and bred in the laboratory. The test morphology of this foraminifers is strongly affected by environmental conditions. Different forms of this species occur around Puerto Rico in areas submitted to different pollutants. The laboratory specimens will be submitted to different pollutants to determine their effect in the test morphology.

G. Benthic Biology

Two new projects have been started this year to study the ecology of seagrass beds and mangrove root communities. These communities are the most common, most productive and most important ecosystems in tropical near-shore environments. The studies are designed to determine the effects of energy related industrial activities on the environment where these communities are found. These studies will determine the species composition, species diversity, biomass, zonation, pigment composition and phenotypic variations in each community.

17. Expected Results in FY-1977

Only those projects that have a direct relationship to the new research plan now under development will be continued. The master research plan which will order the integrated research effort over the next five years should be ready for review by BER in early FY-1977. Some modification of this plan may be forthcoming with the appointment of new Director of the Program.

Primary emphasis will be given to the collection of physical chemical and biological data on the Guayanilla Bay area. Analysis and interpretation of physical oceanographic data is scheduled to begin in January, 1978 with the appointment of a Physical Oceanographer.

It is now anticipated that the sea-water aquarium will be fully operational by early FY-1977.

18. Expected Results in FY-1978

The Program will be strengthened this year by the addition of three staff positions; one Scientist and two Research Associates. Work will be continued in Guayanilla along lines outlined in the Master Research Plan. Under the guidance of internal and external reviews, the Program will be modified as necessary to meet the objectives of ERDA.

19. Description and Explanation of Other Services

	<u>FY-1976</u>	<u>FY-1977</u>	<u>FY-1977</u>	<u>FY-1978</u>
Power	10,500	3,600	13,000	13,000
Vehicles	1,500	500	5,000	2,000
Equip. Maintenance	2,500	900	4,000	3,500
Shop Charges	1,000	-	-	-
Electronic Charges	2,000	-	-	-
Reactor Charges	1,000	-	-	-
Reproduction Charges	1,000	500	2,500	2,000
Computer	2,000	500	2,000	2,000
Consultant Fees	800	-	-	-
Miscellaneous	6,500	500	2,000	2,000
Transp. & Comm.	1,500	500	2,500	2,000
Tuition	900	-	-	-
Rental of Equipment	-	-	-	-
Annual Leave	4,000	1,000	6,000	6,000
Totals	<u>\$ 35,200</u>	<u>\$ 8,000</u>	<u>\$ 37,000</u>	<u>\$ 32,500</u>

20. Description of Capital Equipment by Fiscal Year

The Multichannel Data Acquisition System will be used to record parameters such as temperature, salinity, D.O., and pH in the aquarium laboratory.

The temperature Control and Cycling System will also be used in the aquarium laboratory to provide a controlled temperature set up.

The microscope will be used for plankton, benthos and fish work in the laboratory.

The multi-parameter monitoring system will be used for physical profiling of Guayanilla Bay.

The CO₂ analyzer will be used to aid in making productivity measurements in the mangroves of Guayanilla Bay.

Marine Pollution Studies

APPENDIX A (Cont'd.)

Position	Name	Time Devoted	Remarks	FY-1976	FY-1977	FY-1978
Other: (Cont'd.)						
Res. Assist. III	Harold Rojas	50%	Resigned 12-31-75	1,929	--	--
Res. Assist. III	A. Ramirez	100%	Resigned 7-31-75	486	--	--
Res. Assist. III	J. Donaldson	Hourly	7-1-75 - 8-22-75	809	--	--
Res. Assist. II	J.E. Echevarría	100%		5,730	6,000	6,000
Res. Assist. II	J.A. Ramirez	100%		5,436	5,430	5,430
Tech. Assist. III	E. Rodríguez	Hourly	7-1-75 - 8-18-75	982	--	--
Tech. Assist. II	S. De la Rosa	60%	Transferred 40% Bikini 2-1-76	4,200	--	--
Tech. Assist. II	D. Corales	80%	100% starting 7-1-76	4,368	5,700	5,700
Tech. Assist. II	P.A. Cabassa	100%	Started 2-23-76	1,845	5,220	--
Tech. Assist. II	L.L. Cruz	100%	Starting 11-1-77	--	--	5,160
Tech. Assist. II	G. Wingfield	Hourly	7-1-75 - 9-16-75	823	--	--
Tech. Assist. II	C.J. Davis	Hourly	7-1-75 - 6-30-76	2,498	--	--
Tech. Assist. II	J. Pedersen	Hourly	7-1-75 - 8-15-75	113	--	--
Gross Salaries				131,568	44,855	140,880
Overtime Paid				1,408	--	195,250
Christmas Bonus				2,683	--	4,090
Fringe Benefits				15,585	6,300	27,900
Total				151,244	51,155	163,880
					163,880	227,240

APPENDIX B

COST OF EQUIPMENT

Description	FY-1976	FY-1977	FY-1978
Multichannel Data Acquisition and Recording System for environmental aquarium lab	-	16,000	-
Temperature control and cycling equipment	-	6,000	-
Compound microscope with camera attachment	-	3,500	-
Temperature-Salinity Depth-D.O. -pH monitoring system	-	9,000	-
CO ₂ analyzer adapted for field use	-	5,500	-
Two recording current meters at 5,000 ea.	-	-	10,000
Temperature-salinity meter	-	-	2,000
Five recording thermographs at \$400 ea.	-	-	2,000
Gas chromatograph & UV spectrophotometer	-	-	15,000
Field pH meter	-	-	1,000
Microtome & associated equipment	-	-	10,000
Totals	-	\$ 40,000	\$ 40,000





SCHEDULE 189

Additional Explanation for Operating Costs
University of Puerto Rico - Contract No. E-(40-1)-1833

BUDGET FY - 1978

Oak Ridge Operations

189 No. 82
Rev. 5/14/76

1. Project Title: Health Impact of Hydroelectric Power Reservoirs in Tropics
2. Security Classification Unclassified
3. Budget Activity No.: RT 01 01
4. Date Prepared: April 1976
5. Method of Reporting: Annual Report
6. Working Location: Río Piedras, Puerto Rico
7. Person in Charge: William R. Jobin, Sc. D.
8. Project Term: Continuing Effort

9. <u>Man Years:</u>	<u>FY-1976</u>	<u>FY-1977</u>	<u>FY-1978</u>
a. Scientific	1.80	1.90	1.90
b. Other Direct	.16	.00	2.50
	<hr/>	<hr/>	<hr/>
Total	1.96	1.90	4.40

10. <u>Operating Costs:</u>				
a. Direct salaries plus Fringe Benefits (from Appendix A)	\$ 29,800	\$ 5,800	\$ 35,000	\$ 57,000
b. Overhead Costs (56% of a.)	22,300	4,400	19,600	32,000
c. Travel	500	0	0	1,000
d. Materials and Supplies	2,700	0	1,400	5,000
e. Other Services (Itemized in Item 19)	4,700	4,800	4,000	5,000
	<hr/>	<hr/>	<hr/>	<hr/>
Total	<u>\$ 60,000</u>	<u>\$ 15,000</u>	<u>\$ 60,000</u>	<u>\$ 100,000</u>

11. <u>Equipment Obligations:</u>	\$ 7,000	---	\$ 5,000	\$ 5,000
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12. PUBLICATION AND RESEARCH PROGRESS

PROJECT TITLE	INVESTIGATORS	PHOTOGRAPH PREPARED	DATA COLLECTED			MANUSCRIPT PREPARATION				PUBLICATION STATUS			JOURNAL
			In Part	Complete	Organized	Rough	Semi Final	Final	Submitted	Accepted	In Press		
Field Evaluation of Sampling Techniques in Tropical Reservoirs	W. Jobin F. F. Ferguson	X	X	X	X	X	X	X	X				Malacologia
Cost-Benefits for Molluscicides in Reservoirs	W. Jobin C. Nazario	X	X	X	X	X	X	X					Bull. W.H.O.
Comparative Ecology of Two Reservoirs in Puerto Rico	E. Pagán R. Pérez V. A. López W. Jobin	X	X	X									
Ecological Survey of Reservoirs in Puerto Rico	W. Jobin R. A. Brown	X	X										
Laboratory Study of Decoy Snail Technique for Control of Bilharzia in Reservoirs	W. Jobin R. A. Brown A. Laracuente	X	X										

13. Reports and Presentation, FY 1976

None

14. Purpose, Need, and Scope

This study examines the ecology of existing hydroelectric reservoirs in Puerto Rico, in order to determine the factors which cause or prevent health problems related to the reservoirs. The major health problem investigated is schistosomiasis. Methods will be developed for prediction of the extent of disease transmission to be expected in new reservoirs being designed but not yet constructed. Alternate design of reservoirs and other preventive or control measures will be studied. In total this project attempts to assess environmental and health impact of proposed hydroelectric reservoirs, and to develop methods to minimize that impact.

New facilities for electrical power generation in the tropics and developing countries are primarily hydroelectric projects, with increased emphasis in the more industrialized countries on oil-fired steam generators. Nuclear power sources are further in the future. Thus the largest single grant in the history of the Interamerican Development Bank was for the Salto Grande hydroelectric Project in Uruguay, and the major category in the Bank's 1974 loans for energy production was for hydroelectric power.

Power production in Africa has also centered on such hydroelectric projects as the Aswan Dam on the Nile, Kariba Dam on the Zambezi River, Kainji Dam in Nigeria, and the Volta Lake in Ghana. These dams and reservoirs cause immense changes in ecology, especially increases in diseases related to proximity of man with water. In each of the African cases cited, schistosomiasis has significantly increased due to construction of the reservoirs.

Existing reservoirs in Puerto Rico are primarily for hydroelectric power and irrigation. The 25 major reservoirs will be studied for one year to select six which represent various ages, sizes and levels of eutrophication. For the following two years the six reservoirs will be studied to determine water temperature, volume and quality, algal productivity of macroscopic vegetation, number and species of mollusks, insects and fish. Where bilharzia transmission occurs it will be measured quantitatively. Available computer models for predicting water temperature, algal productivity and mollusk populations will be calibrated with data from the first year of observation and then used to predict the second year. Field measurements will be used to validate the models for the second year data. These models will then be available for prediction on other reservoirs proposed for Puerto Rico and other

Caribbean sites. Available methods for control of bilharzia transmission will be studied for cost and benefits and the optimum measures will be specified to the Health Department. Modifications in original design will be evaluated for recommendations on future reservoirs. A proposal will be made to the power authority that owns the reservoirs in Puerto Rico for methods to eliminate the risk of bilharzia.

Sampling Program

In a recently published study by Jobin and Ferguson (1973) on 12 reservoirs in Puerto Rico which contained the snail hosts of schistosomiasis it was determined that populations of the snails could be quantitatively predicted on the basis of measured water temperature, habitat volume, and mass of vegetation or food, thus these factors will be monitored bi-monthly.

Another recent publication by Jobin (1974) on the effects of water level fluctuation in reservoirs on snail populations had determined that drawdown of the reservoir water level at about 0.1 cm per hour vertically will strand the snails, exposing them to death by dessication. Previous studies by the TVA showed that slightly faster drawdown rates of 0.4 cm per hour can be used to control the anopheline mosquitoes which spread malaria. Thus the field studies will make careful measurements of shore slope, water level recession, and snail and mosquito populations.

The specific measurements to be made on the reservoirs will be:

1. Water level and reservoir volume
2. Water temperature in shore zone
3. Dissolved oxygen and productivity in shore zone
4. Physical stability of shore-eroding or stable
5. Shore slope and composition of soil
6. Extent of macroscopic vegetation
7. Snail populations
8. Schistosome infections of snails
9. Patterns of human water contact with infected waters
10. Human fecal contamination of reservoirs
11. Insect population, especially anopheline mosquitoes
12. Turbidity of water
13. Extent of light penetration and zone of algal productivity (secchi disk)
14. Total phosphate concentration
15. Algae species and numbers

15. Relationship with Other Projects

It is expected that the Puerto Rico Water Resources Authority and the U. S. Army Corps of Engineers will contribute substantially to

the study since these two agencies own existing reservoirs in Puerto Rico and are constructing several new reservoirs. The Health Department is supplying a five man field crew full time for the reservoir surveys.

16. Technical Progress - FY-1976

A. Snail Surveys and Eutrophication

As of March 15, 22 of the 25 major reservoirs have been surveyed by a joint team including personnel of the Health Department and P.R.N.C. Two of these were intensive surveys conducted with additional help from the U.P.R. Regional College at Cayey. In the other 20 surveys the primary emphasis was on water chemistry and snail populations. All reservoirs except 4 contained aquatic snails and these 4 were extremely clear lakes of low productivity. Biomphalaria glabrata, the intermediate host in schistosomiasis was found in Lake Carraizo, Lake Carite, Lake Dos Bocas, Lake Garzas and Tortuguero Lagoon. All are hydroelectric reservoirs except for Tortuguero Lagoon.

The other predominant snail species were Marisa cornuarietis in 13 reservoirs, Tarebia granifera in 11 reservoirs, and Physa cubensis in 10 reservoirs. In all the reservoirs which contained Biomphalaria glabrata, at least two and usually three of these other species of snails were present.

A large ampullarid snail, probably a species of Pomacea, was found in Lake Carite, Cidra Lake and Lake Carraizo. These reservoirs also contained large masses of floating water hyacinth and showed gross evidence of eutrophication such as algae blooms and anaerobic bottom sludges. However, Lakes Dos Bocas and Villalba were also eutrophied with water hyacinth but no Pomacea.

B. Hydroelectric Impoundments - Water Chemistry

As a part of the first year survey, 2 to 10 samples have been taken from each lake for chemical analysis. The laboratory's current capability includes dissolved oxygen, pH, color, turbidity, chloride, total EDTA hardness, iron, nitrate and total phosphate. When a field laboratory is available, total alkalinity and free CO₂ will be added.

The field survey of the lakes is almost complete. All of the analytical work should be completed by May and well before the end of the fiscal year. To date analyses for 13 lakes (75 samples) have been completed. The lakes in general tend to be clean with low levels of phosphate and nitrate. Only Luchetti of Yauco had between 0.5 and 1.0 mg/liter of nitrates. It is interesting that Cidra Lake which is known

to be heavily contaminated and whose shore is overgrown with water hyacinths has barely detectable phosphates and about 0.2 mg/liter nitrates. This would support those reports which suggest that the water hyacinth is very efficient in removing nutrients from the water. Cidra Lake has about twice as much chloride as any of the other lakes. Perhaps this will serve as an indicator of contamination. Samples taken from lakes early in the year had very low iron content, while samples taken from other lakes during the winter had much more iron. This may reflect overturn of previously stratified lakes. Time studies will be necessary to verify this. At this time there is no obvious correlation between snails and chemistry. The snail prediction models are in operating condition on the U.P.R. computer. A mobile laboratory and boats have been purchased and will be outfitted with basic equipment in time to begin the intensive lake studies in July 1976. Vehicles to tow the laboratory and boat trailers have been requested.

Expected Results - Transition Period 1976

A general review of the condition of the lakes with respect to floating vegetation will be completed. The data from the first year's survey will be reviewed and six reservoirs selected for intensive study. The mobile laboratory will be taken for one week to each reservoir and the first of 5 quarterly surveys will be completed.

17. Expected Results - FY-1977

A complete annual cycle of 4 intensive surveys on each of the six reservoirs will be completed. A computer model of snail populations will be developed for each reservoir and snail populations will be predicted for the next year (FY-1978).

18. Expected Results - FY-1978

A second annual cycle of 4 intensive surveys on the six reservoirs will be completed. The observed snail populations will be compared with the previous computer predictions in order to verify the reliability of the model. Appropriate adjustments will be made to the model to generalize it for predictions in any proposed reservoir. Methods for controlling snail populations in existing reservoirs will be evaluated and presented to the Power Authority for preliminary trials.

19. Description and Explanation of Other Services:

	<u>FY-1976</u>	<u>TQ</u>	<u>FY-1977</u>	<u>FY-1978</u>
Power	\$2,200	\$ 550	0	0
Shop Charges	-	-	-	-
Reproduction Charges	500	1,250	1,000	1,000
Transportation & Communication	-	-	-	-
Equipment Maintenance	500	1,000	-	1,000
Tuition	-	-	-	-
Computer	1,000	1,000	1,000	1,000
Annual Leave	-	-	-	-
Vehicles	500	1,000	2,000	2,000
Miscellaneous	-	-	-	-
Electronic Charges	-	-	-	-
Rental of Equipment	-	-	-	-
Consultant Fees	-	-	-	-
Reactor Charges	-	-	-	-
TOTAL	\$4,700	\$ 4,800	\$4,000	\$ 5,000

20. Description of Capital Equipment by Fiscal Year

Pumps, flow measuring devices and plumbing for studies on water level fluctuations	\$7,000	\$	- \$5,000	\$ 5,000
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APPENDIX A

Position	Name	(%) Time devoted	Remarks	FY-1976	FY-1977	FY-1978
<u>Scientific Personnel:</u>						
Head	William R. Jobin, Sc.D.	40%	60% in Division	\$ --	\$ 10,000	\$ 10,000
Senior Scientist I	Raymond A. Brown	50%	50% in Division	20,472	5,118	10,235
Res. Associate I	Martha Caballero		Terminated			10,235
Scientific Assoc. II	María M. Bhajan	100%	12/15/75	2,281	--	--
Research Assoc. II	Carmen Vivero	100%	Started 9/25/75*	3,000	--	--
Research Assoc. II	To be appointed	100%		---	10,000	10,000
Research Assoc. II	To be appointed	100%		---	--	7,500
				---	--	7,500
<u>Technical Personnel:</u>						
Adm. Assoc. II - Sec.	Blanca Maldonado	50%		---	--	4,125
Tech. Assistant II	Angel Laracuente	50%	Started 3/1/76	850	--	--
Hourly Employees				217	--	--
Gross salaries				\$ 26,820	\$ 5,118	\$ 30,235
Christmas bonuses (4%)				368	---	456
Sub-total				\$ 27,188	\$ 5,118	\$ 30,691
Fringe benefits				2,613	720	4,300
Total				\$ 29,801	\$ 5,838	\$ 34,991
						\$ 57,180

* Started 9/25/75 with Clark Foundation, Transferred to Project 82.

APPENDIX B
COST OF EQUIPMENT

Description	FY-1976	FY-1977	FY-1978
1. Pumps & flow measuring devices	-	\$ 5,000	\$ 5,000





SCHEDULE 189

Additional Explanation for Operating Costs
University of Puerto Rico - Contract No. E-(40-1)-1833

BUDGET FY - 1978

Oak Ridge Operations

189 No. _____
Rev. 5/14/76

1. Project Title: Environmental Research Park
2. Security Classification: Unclassified
3. Budget Activity No.: RT-03-04
4. Date Prepared: April, 1976
5. Method of Reporting: Annual Progress Report
6. Working Location: Rio Piedras, Puerto Rico
7. Person in Charge: Dr. Richard G. Clements
8. Project Term: Continuing Effort

9. <u>Man Years:</u>	<u>FY-1976</u>	<u>FY-1977</u>	<u>FY-1978</u>
a. Scientific	-	0.18	0.90
b. Other Direct	-	-	1.00
	<hr/>	<hr/>	<hr/>
Total	-	0.18	1.90

10. <u>Operating Costs:</u>				
a. Direct salaries plus Fringe Benefits (from Appendix A)	-	2,850	15,112	26,785
b. Overhead Costs	-	2,150	8,463	14,890
c. Travel	-	400	300	2,000
d. Materials and Supplies	-	850	625	6,316
e. Other Services (Itemized in Item 19)	-	-	-	-
	<hr/>	<hr/>	<hr/>	<hr/>
Total	-	6,250	25,000	50,000
	<hr/>	<hr/>	<hr/>	<hr/>

11. Equipment Obligations:

12. Publications and Research Progress

None

13. Reports and Presentations, FY-1976

None

14. Purpose, Need and Scope

This Program will determine the feasibility of setting aside an outdoor laboratory where the impact of man's activities on the natural environment, especially those related to energy, can be assessed. Such a program would incorporate the National Environmental Research Park objectives of (1) developing methods to assess and monitor the environmental impact of man's activities, (2) developing methods to estimate and predict the environmental response to proposed and on-going activities, and (3) to demonstrate the impact of various activities and evaluate methods to minimize adverse impacts.

15. Relationship to Other Projects

The Program would become part of the National network of environmental parks that are being set aside to meet the objectives of the National Environmental Research Park (NERP).

16. Technical Progress FY-1976

New Project

17. Expected Results in FY-1977

During this year preliminary characterization of the site will be done including the preparation of soil and vegetation maps, compilation of a bibliography of research conducted in the areas and preparation of a proposal to designate the site as a National Environmental Research Park.

18. Expected Results in FY-1978

Anticipated results will depend on the acceptance and funding of the Program as a National Environmental Research Park.

19. Description and Explanation of Other Services

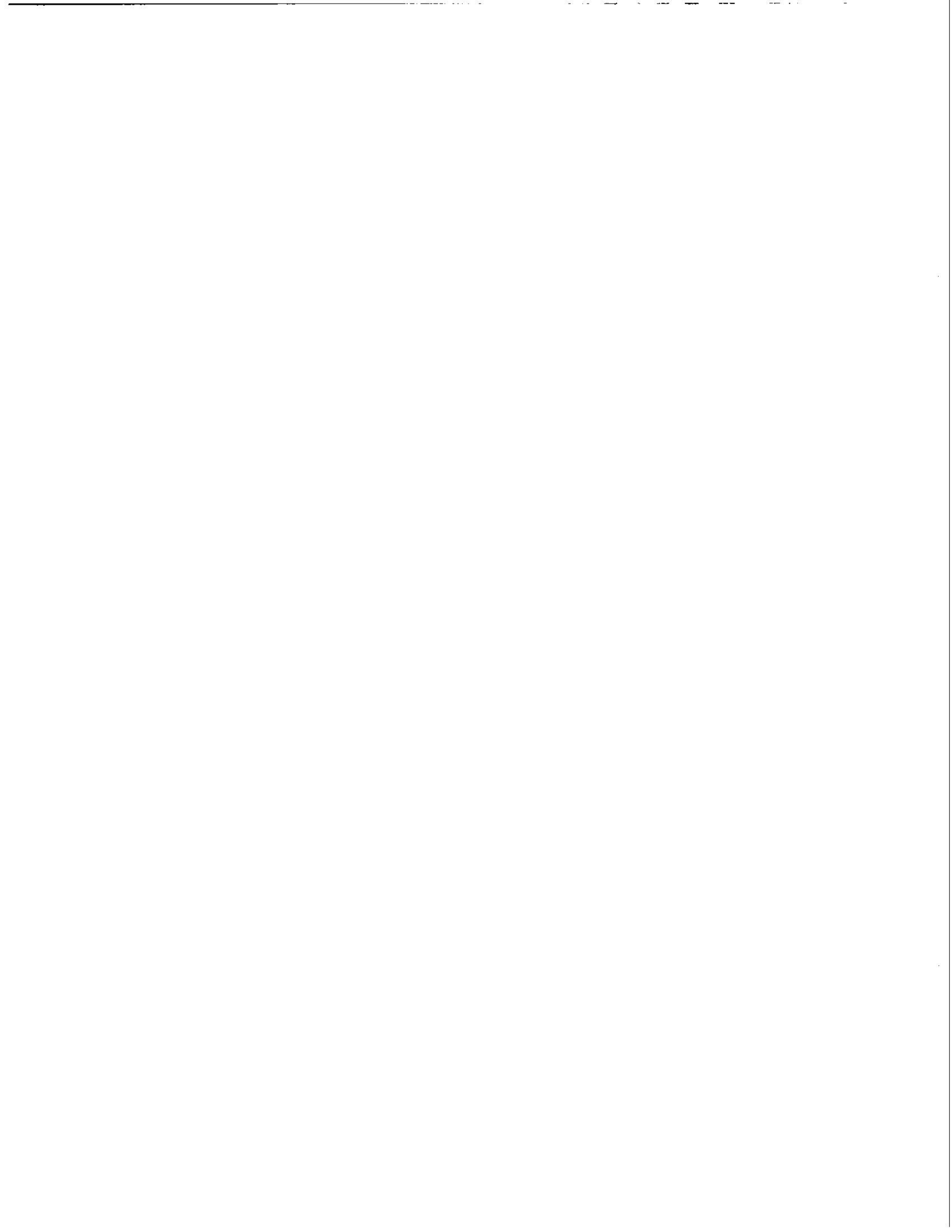
None

20. Description of Capital Equipment by Fiscal Year

None

APPENDIX A

Position	Name	Time Devoted	Remarks	FY			
				1976	1977	1978	1979
<u>Scientific Personnel:</u>							
Senior Scientist I	Richard G. Clements	18%		-	983	3,933	3,933
Scientist II	Arthur MCB. Block	18%		-	-	3,060	3,060
Scientist I	William Bhajan	18%		-	630	2,520	2,520
Sci. Assoc. III	Elvira Cuevas	18%		-	450	1,800	1,800
Sci. Assoc. III	Brent Holben	18%		-	432	1,728	1,728
Res. Assoc.			To be appointed October, 1977	-	-	-	10,000
Gross Salaries							
				-	2,495	13,041	23,041
Christmas Bonus							
				-	-	215	455
Fringe Benefits							
				-	349	1,856	3,289
TOTAL				-	<u>2,844</u>	<u>15,112</u>	<u>26,785</u>





SCHEDULE 189

Additional Explanation for Operating Costs
University of Puerto Rico - Contract No. E-(40-1)-1833

BUDGET FY - 1978

Oak Ridge Operations

Rev. 189 No. 65
5/14/76

1. Project Title: Bikini
2. Security Classification: Unclassified
3. Budget Activity No.: RT 03 01
4. Date Prepared: April 1976
5. Method of Reporting: Annual and Monthly Reports
6. Working Location: Mayaguez, Puerto Rico
7. Person in Charge: J. G. González
8. Project Term: Through FY-1977

9. <u>Man Years:</u>	<u>FY-1976</u>	<u>FY-1977</u>	<u>FY-1978</u>
a. Scientific	2.10	2.00	-
b. Other Direct	2.30	2.70	-
	<u>4.40</u>	<u>4.70</u>	<u>-</u>

10. Operating Costs:

a. Direct salaries plus Fringe Benefits (from Appendix A)	\$39,000	\$10,000	\$47,000	-
b. Overhead Costs (56% of a.)	29,300	6,000	26,300	-
c. Travel	9,500	1,000	5,900	-
d. Materials and Supplies	8,700	5,000	10,000	-
e. Other Services (Itemized in Item 19)	8,500	1,750	10,800	-
	<u>95,000</u>	<u>23,750</u>	<u>100,000</u>	<u>-</u>

11. Equipment Obligations: \$6,000 -- \$2,000 -

12. Publications and Research Progress

None

13. Reports and Presentations, FY-1976

None

14. Purpose, Need and Scope

Objectives of the Bikini Project are:

(1) To describe the distribution patterns of plutonium and americium in the marine waters, sediments and organisms of Bikini Atoll.

(2) To determine the influence of physical, chemical and biological parameters upon the movement of the nuclides of these two actinide elements through the marine biogeochemical system.

Although plutonium and, to a lesser degree, americium are among the most hazardous elements known to man, little is known of their interaction with the waters, sediments and biota of the nearshore marine environment. The production, use and accidental release of these radionuclides may be expected to increase from defense and peaceful technology, especially in the production of electrical power. Because of this, detailed information is needed concerning the concentration of these radionuclides into specific reservoirs in the marine environment or organisms which would limit their use by man.

The scope of the project includes the description of the physical, chemical and biological processes which determine the movement of the radionuclides Pu²³⁸, Pu^{239,240} and Am²⁴¹ from the sediments of the weapons craters at Bikini Lagoon into the waters, plants and animals and the distribution patterns of the radionuclides in the components of the system. It also includes the transfer rates and distribution patterns of plutonium and americium from the water and sediments through specific planktonic, pelagic and benthic ecosystems.

15. Relationship to Other Projects

The Bikini biogeochemical studies of the transuranium elements were started as a cooperative program between the Laboratory of Radiation Ecology, University of Washington; Lawrence Livermore Laboratory, University of California; and the Puerto Rico Nuclear Center, University of Puerto Rico. Cooperation between the three laboratories has continued through exchange and comparison of

duplicate analyses of samples and standards. In addition, Battelle Northwest Laboratories have supplied standard solutions of Pu²⁴² for determining chemical yield.

16. Technical Progress in FY-1976

The progress achieved thus far in our PRNC laboratory is the following:

I. October-November 1974 Resurvey trip to Bikini

A. Sediment Samples

Sediment samples collected at 46 different stations were brought to PRNC laboratory where grinding, sieving and separation into fine and coarse fractions was performed. Both fractions were analyzed for plutonium content and gamma counting carried out to determine Am²⁴¹, Eu¹⁵⁵, Sb¹²⁵, Rh¹⁰², Cs¹³⁷, Bi²⁰⁷, and Co⁶⁰. Horizontal distribution patterns and nuclide ratios have been calculated for the transuranium alpha emitters.

B. Sea Water Samples

Precipitation of the ten 20-liter water samples collected during 1974 resurvey trip was performed in our laboratory. Dissolution and analyses of the precipitates in order to determine Am and Pu content have been started.

II. Fall 1972 Trip

A. Sediment Core Samples

C#2 core (bottom half of core) was analyzed to a depth of 207 cm. The core, 306 cm long (10 ft), was taken in the Bravo Crater. Vertical profiles of Pu²³⁸, Pu²³⁹, Am²⁴¹, Co⁶⁰, Rh¹⁰², Sb¹²⁵, Cs¹³⁷, and Eu¹⁵⁵ were determined. The first half of this core was analyzed for the above radionuclides and the results reported during FY-1975.

B. Fish Samples

Analyses of fish samples for the three transuranium radionuclides have been continued in order to get additional information to define the mechanisms which cause the difference in uptake of Pu²³⁸ and Pu²³⁹ by marine organisms.

17. Expected Results in FY 1977

I. Plankton Samples

The forty-five plankton samples collected in 1974 will be analyzed for the three transuranium radionuclides. The results will be related to the current patterns in Bikini Lagoon, the patterns of the same radionuclides observed in the other series of plankton collected in 1972, to the water samples collected in 1974, and to the distribution patterns of the radionuclides observed in the bottom sediments.

II. Sediment Core Samples

Analyses of radionuclide content in the remaining sediment core samples collected during the fall of 1972 in the Bravo, Tewa and Zuni Craters will be completed.

At present four alpha detectors are being used in our work. This limits the number of samples which may be analyzed because of the long counting time required. During FY-1977 we plan to buy two additional detectors to replace the damaged ones.

18. Expected Results in FY-1978

Project terminates at the end of FY-1977.

19. Description and Explanation of Other Services

	<u>FY-1976</u>	<u>FY-1970</u>	<u>FY-1977</u>	<u>FY-1978</u>
Power	\$4,000	\$1,000	\$6,000	---
Shop Charges	---	---	---	---
Reproduction Charges	500	200	1,000	---
Transp. and Comm.	500	200	800	---
Equipment Maintenance	500	200	500	---
Tuition	---	---	---	---
Computer	---	---	---	---
Annual Leave	1,000	---	500	---
Vehicles	---	---	---	---
Miscellaneous	1,500	150	2,000	---
Electronic Charges	500	---	---	---
Rental of Equipment	---	---	---	---
Consultant Fees	---	---	---	---
Reactor Charges	---	---	---	---
	<u>8,500</u>	<u>\$1,750</u>	<u>\$10,800</u>	<u>---</u>

20. Description of Equipment

The two alpha detectors we plan to buy in FY-1977 are needed for counting the large number of plutonium and americium samples to be analyzed in the project.

POSITION	NAME	TIME DEVOTED	REMARKS	FY-1976	FY-1977	FY-1978
<u>Scientific Personnel:</u>						
Scientist II	K. Matters	16%	Eff. 7/1/76	---	\$4,625	---
Scientist II	R. Lee	27%	10/1-11/30/75	980	---	---
Scientist I	J. López	25%	---	---	3,875	---
Scientist I	F. Muñoz	100%	Res. 9/18/75	3,262	---	---
Senior Assoc.	B. Smith	50%	Eff. 11/15/75	6,600	---	---
Res. Assoc. II	R.J. Santiago	100%	---	9,156	2,300	---
Res. Assoc. I	G. Arocho	100%	Res. 1/21/76	3,331	---	---
Res. Assoc. II	D. Carrillo	---	Hourly 8/1 to 9/2/75	465	---	---
Res. Assoc. I	M. Pérez	100%	---	6,000	1,500	6,000
<u>Other:</u>						
Tech. Assist. II	L. L. Cruz	100%	---	---	5,160	---
Engineer II	H. Besselievre	85%	50%-FQ; 85% FY-77	---	2,000	---
Tech. Assist. II	S. de la Rosa	40%	Eff. 2/1/76	840	1,260	---
Res. Assist. III	H. Serra Lugo	100%	Eff. 1/26/76	2,380	---	---
Adm. Assoc. I - Sec.	P. Ortega	20%	Eff. 9/1/75	1,131	1,740	3,480
Gross Salaries				\$34,135	\$8,800	\$39,731
Christmas Bonus				961	---	1,170
Fringe Benefits				3,448	1,230	5,726
TOTAL				\$38,564	10,030	\$46,627

Bikini Project

189 No. 65

APPENDIX B

COST OF EQUIPMENT

Description	FY-1970	FY-1977	FY-1978
Two alpha detectors and associated electronics	---	\$2,000	---





SCHEDULE 189

Additional Explanation for Operating Costs
University of Puerto Rico - Contract No. E-(40-1)-1833

BUDGET FY - 1978

Oak Ridge Operations

189 No. 80
Rev. 5/14/76

1. Project Title: Epidemiological Models for Predicting Health Impact of Energy Related Facilities
2. Security Classification Unclassified
3. Budget Activity No.: RT 01 01
4. Date Prepared: April 1976
5. Method of Reporting: PRNC Annual Report
6. Working Location: Rfo Piedras, Puerto Rico
7. Person in Charge: William R. Jobin, Sc. D.
8. Project Term: Terminates FY-77

9. <u>Man Years:</u>	<u>FY-1976</u>	<u>FY-1977</u>	<u>FY-1978</u>	<u>FY-1979</u>
a. Scientific	1.50	0.75	1.00	0
b. Other Direct	0.75	-	-	-
	<hr/>	<hr/>	<hr/>	<hr/>
Total	2.25	0.75	1.00	0

10. <u>Operating Costs:</u>				
a. Direct salaries plus Fringe Benefits (from Appendix A)	\$ 28,400	\$ 12,850	\$ 20,500	0
b. Overhead Costs (56% of a.)	21,300	9,600	11,500	-
c. Travel	1,300	---	---	-
d. Materials and Supplies	6,000	250	5,000	-
e. Other Services (Itemized in Item 19)	38,000	1,050	3,000	-
	<hr/>	<hr/>	<hr/>	<hr/>
Total	\$ 95,000	\$ 23,750	\$ 40,000	0

11. Equipment Obligations: --- --- ---

12. PUBLICATION AND RESEARCH PROGRESS

PROJECT TITLE	INVESTIGATORS	PROTOCOL PREPARED	DATA COLLECTED		MANUSCRIPT PREPARATION			PUBLICATION STATUS			JOURNAL	
			In Part	Complete	Organized	Rough	Semi-Final	Final	Submitted	Accepted		In Press
Guidelines for Sampling of Cercariae in the Field	H. Negrón W. Jobin	X	X	X	X	X						
Epidemiology of Bilharzia in Parcelas of Puerto Rico	H. Negrón E. Ruiz W. Jobin	X	X	X	X	X						
Prevalence of Bilharzia in Puerto Rico 1976	H. Negrón W. Jobin	X										

13. Reports and Presentations, FY 1976

None

14. Purpose, Need and Scope

In the development of new energy production facilities and in programs to reduce the pollution from existing facilities, planners need tools for predicting the environmental and health impact of these changes. Since the Puerto Rico Nuclear Center is in the tropics, special concern is given to tropical diseases related to hydroelectric impoundments which in Latin America and Africa have had considerable impact on schistosomiasis, malaria, onchocerciasis and other parasitic diseases. More subtle diseases caused by air pollution from oil-fired steam plants also occur in tropical areas, especially in those undergoing rapid industrial development, and these also merit attention. The purpose of this project is to develop epidemiological models which can be used by planners to predict the changes in disease prevalence and incidence related to the power facilities in Puerto Rico and other tropical areas.

This project will be concerned with laboratory and field investigations necessary for formulation, calibration, and verification of models related to specific diseases. In addition, the completed models will be used to examine alternate strategies for reducing the related diseases in Puerto Rico and other tropical areas.

The specific objectives are to develop a model of schistosomiasis transmission based on hydroelectric reservoirs as the epidemiological unit. The reservoirs in Puerto Rico to be modelled will include Lago Loiza and Rio Blanco. In addition, a model will be developed for Volta reservoir in Ghana, for Taveras and Bao reservoirs in the Dominican Republic and for some of the larger power reservoirs on the São Francisco River in Brazil. The models will be verified with the field data and used to predict effects of various designs, operational schedules and control programs for these reservoirs.

15. Relationship to Other Projects

The activities under this study utilize the biological data gathered in the Project on Hydroelectric Reservoirs.

16. Technical Progress in FY-1976

About half of the objectives have been achieved under the proposed modelling program, in accordance with the limitation on funds.

A. Simulation Models for Schistosomiasis around reservoirs

The logic and Fortran IV programs have been obtained for

a snail population model, a mammal population model, and three schistosome transmission models. The snail model has been brought up to operation on the U.P.R. computer.

B. Skin-Test survey for prevalence of bilharzia

Preparations for the 1976 skin test survey for bilharzia have been completed. The survey begins in April and will terminate in mid-May. An optically-scanned data sheet was prepared for each of the 20,000 school children to be tested. The data sheet was designed in consultation with the U.P.R. computer center for rapid processing of the large amount of epidemiological data being collected. A computer program was developed and finalized to process the data directly from the optical-scanner into tables for comparison with the previous skin tests of 1963 and 1969.

To carry out the testing program in the schools, arrangements were made with the Department of Public Instruction for statistical information and coordination with individual teachers. A randomized 25% sample of 5th grade classrooms was selected from the present school system and scheduled for testing in April and May. Arrangements were complete with the Department of Health for six nurses to do the testing with assistance from other regional personnel. All materials including antigen and disposable syringes have been obtained.

C. Summary of Available Epidemiological Data for Puerto Rico

Available epidemiological data has been summarized for 5 small communities in Puerto Rico where schistosomiasis transmission has been very intense in the past. Data and maps are available on human populations, on infection rates and on snail populations. Detailed information on all aspects of transmission is available for three of them. In addition the entire island has been divided into 12 zones and basic information on sanitation, human population, and schistosomiasis prevalence has been summarized in tabular form.

D. Epidemiological Data for African and Brazilian Reservoirs

During the year, site visits were made to Volta Reservoir in Ghana and Três Marias, Furnas and Volta Grande Reservoirs in Brazil to gather engineering and epidemiological data. Data summaries were also obtained for Lake Nasser in Egypt, Lake Kariba, in Rhodesia and Zambia, Kassou Lake in the Ivory Coast and Lake Kainji in Nigeria. Field Surveys of Taveras and Bao Reservoirs in the Dominican Republic will take place in June 1976, to complete the international data gathering.

Of these 10 hydroelectric reservoirs, the most complete information is available for Volta Reservoir in Ghana and preliminary modelling was completed on one phase of schistosomiasis transmission in the Afram arm of the lake where an epidemic of Schistosoma haematobium

occurred soon after filling of the reservoir. Field and laboratory data was analyzed on dispersion of schistosome miracidia and cercariae, related to snail populations, and a comparison was made between the effects of a chemotherapy program and a snail control program. The simple model analysis showed that the snail control program would cause a much greater decrease in incidence rates for local inhabitants, than would the chemotherapy program.

Expected Results Transition Quarter

Dependent on funding - see original proposal

17. Expected Results FY-1977

Dependent on funding

18. Expected Results FY-1978

Dependent on funding

19. Description and Explanation of Other Services:

	<u>FY-1976</u>	<u>FY-1977</u>	<u>FY-1978</u>	
Power	\$ 8,000	---	---	Terminates
Shop Charges	---	---	---	
Reproduction Charges	600	250	1,000	
Transportation & Communication	---	---	---	
Equipment Maintenance	1,200	---	---	
Tuition	---	---	---	
Computer	---	---	1,000	
Annual Leave	---	---	---	
Vehicles	---	250	1,000	
Miscellaneous	23,200	550	0	
Electronic Charges	---	---	---	
Rental of Equipment	---	---	---	
Consultant Fees	5,000	---	---	
Reactor Charges	---	---	---	
Total	\$38,000	\$ 1,050	\$ 3,000	

20. Description of Capital Equipment by Fiscal Year

None



SCHEDULE 189

Additional Explanation for Operating Costs
University of Puerto Rico - Contract No. E-(40-1)-1833

BUDGET FY - 1978

Oak Ridge Operations

189 No. 79
Rev. 5/14/76

1. Project Title: Effects of Fossil Fuel Pollutants on Human Health and Biota in the Tropics
2. Security Classification Unclassified
3. Budget Activity No.: RT 01 01
4. Date Prepared: April 1976
5. Method of Reporting: Annual Report
6. Working Location: Río Piedras, Puerto Rico
7. Person in Charge: William R. Jobin, Sc. D.
8. Project Term: Terminates FY-77

9. <u>Man Years:</u>	<u>FY-1976</u>	<u>FY-1977</u>	<u>FY-1978</u>
a. Scientific	2.00	0.75	0
b. Other Direct	.33	--	-
	<hr/>	<hr/>	<hr/>
Total	2.33	0.75	0

10. Operating Costs:

a. Direct salaries plus Fringe Benefits (from Appendix A)	\$39,400	\$ 6,600	\$20,200	0
b. Overhead Costs (56% of a.)	29,600	5,000	11,300	-
c. Travel	1,000	---	500	-
d. Materials and Supplies	3,000	---	3,300	-
e. Other Services (Itemized in Item 19)	24,000	12,650	4,700	
	<hr/>	<hr/>	<hr/>	<hr/>
Total	<u>\$97,000</u>	<u>\$24,250</u>	<u>\$40,000</u>	<u>0</u>

11. Equipment Obligations: --- --- --- -



Schedule 189

Additional Explanation for Operating Costs
University of Puerto Rico - Contract No. E-(40-1)-1833

Budget FY-1978

Oak Ridge Operations

189 No. 71

1. Project Title: Marine Research Ship Operation Rev. 5/14/76

2. Security Classification: Unclassified

3. Budget Activity No.: RT 03 04

4. Date Prepared: April 1976

5. Method of Reporting: PRNC Annual Report

6. Working Location: Mayaguez, Puerto Rico

7. Person in Charge: J. G. González

8. Project Term: Continuing effort

9. <u>Man-Years:</u>	<u>FY-1976</u>	<u>FY-1977</u>	<u>FY-1978</u>
a. Officers	1.00	0.08	-
b. Crew and Support	<u>6.49</u>	<u>0.24</u>	<u>-</u>
Total	7.49	0.32	-

10. Operating Costs:

a. Direct salaries plus Fringe Benefits (from Appendix A)	\$79,900	\$3,200	-	-
b. Overhead Costs	59,900	2,600	-	-
c. Travel	3,500	2,700	-	-
d. Materials and Supplies	8,000	-	-	-
e. Drydocking	25,000	-	-	-
f. Other Services (Itemized in Item 19)	40,700	12,000	-	-
g. Boat Rental	-	-	\$40,000	\$40,000
Total	\$217,000	\$20,500	\$40,000	\$40,000
Other Credits	32,000	-	-	-
TOTAL	\$185,000	\$20,500	\$40,000	\$40,000

11. Equipment Obligations: \$11,200 - - -

12. Publications and Research Progress:

None

13. Reports and Presentations, FY 1976:

None

14. Purpose, Need and Scope:

The research vessel, R. F. PALUMBO, was built for the USERDA in San Diego, California in 1970-71 and was brought to Puerto Rico in the spring of 1971. The ship was built to carry out Oceanographic research by the Marine Ecology Division of the Puerto Rico Nuclear Center. The PALUMBO will be transferred to another ERDA sponsored laboratory before the end of FY 1976, therefore other plans must be made to carry out the research mission of the Division.

15. Relationship to Other Projects:

Not applicable

16. Technical Progress in FY-1976:

Not applicable

17. Expected Results in FY-1977:

Boat rental funds are requested to charter any of several available boats in Puerto Rico to carry out the research missions associated with the Marine Ecology Division programs.

The Division estimates a need of approximate 120 days per year at a leasing rate of \$250-350/day.

The possibility of purchasing a research vessel from the PRWRA is being explored since it appears that the cost of operating a small vessel (45') which would be adequate for the research needs of the Division would be less than those incurred in rental or leasing.

18. Expected Results in FY-1978:

Not applicable

19. Description and Explanation of Other Services:

	<u>FY-1976</u>	<u>FY-1970</u>
Power	\$3,200	-
Shop Charges	-	-
Reproduction Charges	200	-
Transportation and Communication	800	-
Equipment Maintenance	-	-
Tuition	-	-
Computer	-	-
Annual Leave	1,000	6,000
Vehicles	-	-
Miscellaneous	5,000	6,000
Electronic Charges	1,000	-
Rental of Equipment	-	-
Consultant Fees	-	-
Reactor Charges	-	-
General Expenses (fuel)	<u>29,500</u>	<u>-</u>
	\$40,700	\$12,000

20. Description of Capital Equipment by Fiscal Year

None

Marine Research Ship Operation

189 No. 71

A P P E N D I X A

POSITION	NAME	TIME DEVOTED	REMARKS	FY-1976	FY-1976	FY-1976
Engineer I- Boat Captain	C.G. Bullock	100%		\$16,000	\$1,333	
Eng. Assoc. III	F. Rodríguez	100%		3,465	---	
Tech. Assoc. I	C. Hernández	100%		3,900	---	
Eng. Assoc. III	S. Soler	100%		6,150	---	
Tech. Assoc. I	J. Montalvo	100%		5,790	500	
Tech. Assist. II	J. R. Agrait	100%		5,520	460	
Tech. Assist. III	J. Hernández	100%	Hourly	2,496	---	
Tech. Assist. II	E. Montalvo	100%	Hourly	2,269	---	
Tech. Assist. III	M.B. Cancel	100%	Hourly	4,131	550	
Tech. Assist. II	M.K. Marcari	100%		726	---	
Eng. I	D. Gaskill	100%		596	---	
Eng. Assist. I	A. Ramirez	100%	Hourly	538	---	
Adm. Assist. III	A. Marrero	40%		<u>2,400</u>	---	
	Gross Salaries			\$53,981	\$2,843	
	Christmas Bonus			1,688	---	
	Overtime			<u>14,447</u>	---	
	Subtotal			<u>70,116</u>	<u>2,843</u>	
	Fringe Benefits 14%			<u>9,816</u>	<u>400</u>	
	TOTAL			<u>\$79,932</u>	<u>\$3,243</u>	